

## APPARATUS AND PROCESS FOR CUTTING OF EXTRUDED MATERIAL

### Technical Field

5 The present invention relates generally to the cutting of materials produced in a manufacturing process, and more particularly to materials produced in extrusion manufacturing processes.

### Background of the Invention

10 The invention relates generally to the cutting of materials during a manufacturing process, and more particularly, cutting materials delivered from an extrusion process.

15 It is known in manufacturing to produce a material in a continuously extruded stream, and cut the material to a desired size(s) as it leaves the extruder. In extrusion manufacturing processes, cutting blades may be used to cut materials being extruded, with the cutting blades often being mounted to the hub, or end, of extrusion machinery.

Conventionally, a cutting blade is made of a single piece of high-grade metal, often hardened, which has cutting edges formed integrally with the body portion, the cutting edges being sharpened by using grinding, machining, or similar techniques. The prior art discloses cutting blades made of a single cast, 20 died or cut material that is then sharpened along the edge. One practical drawback of this conventional technology is that when the cutting edge(s) becomes dull, the production process must be shut down so that the cutting blade may be removed,

sharpened and re-installed, or replaced with a new blade. Further, dull blades can lead to misshapen products. The cost of blades, along with the cost of lost production time when the process had to be stopped for the blades to be replaced can be high, in part because the entire cutting mechanism is made from a single, relatively expensive, material.

The foregoing problems have been mitigated in some cases where the blades are sharpened on both sides, which reduces the frequency of sharpening, but the blades are still expensive. With such a configuration, when the initial edges become dull, the entire cutting head is removed, reversed, and reattached so that a new set of sharp edges are available for use. To compensate for such expense, separate cutting blades, which may be sharpened or replaced individually, may be attached to a cutting blade holder, which is secured to the hub or end of the extrusion machinery. Generally, cutting blades are attached to the cutting blade holder using screws. Difficulty occurs when the screws used to attach the blades loosen during use. This requires the process to be shut down so that the screws can be tightened or replaced. Also, the tolerance between the blade and extruder equipment is very tight, frequently less than a few thousandths of an inch, to ensure precise metering of product. Harder materials, such as various forms of carbide, are not suitable for use as a single, integral piece because the carbide is too brittle to be worked in this configuration, and such large pieces of carbide would be very expensive.

What is needed, therefore, is a method and apparatus for cutting extruded materials that enables cutting blades to have longer cutting life, and that are relatively easy and inexpensive to replace when the cutting edge is no longer sharp.

Summary of the Invention

The present invention, accordingly, provides for bonding individual cutting blades to a securing mechanism to produce a less expensive cutting mechanism that is light-weight enough to not distort the product being cut. To this end, a cutting blade holder with at least two channels in the edge is used, and a cutting blade is inserted in each channel on the cutting blade holder, and bonded to the cutting blade holder. Alternatively, each cutting blade may be bonded to a separate cutting blade holder, with at least two such assemblies secured to a rotatable cup attachable to a rotating mechanism such as an extruder shaft.

In one arrangement, the cutting blade holder circumscribes a circular opening that fits over the end or hub of the extrusion machinery. In an alternative arrangement of the invention, the cutting blade holder circumscribes a slot that can be attached to a commercially available cup or cutter head that fits over the end or hub of the extrusion machinery.

An advantage achieved with the present invention is that only the cutting blades need to be made of a high-quality, wear-resistant metal, such as tungsten carbide or carbide coated metals. The cutting blade holder may be made of a material such as a mild steel, which may be bonded to the cutting blades, thus reducing overall material costs substantially.

Another advantage achieved with the present invention is that the cutting blades may be readily secured into the cutting blade holder by means such as brazing or use of a bonding material, which bonds the cutting blade holder and cutting blade materials together when heated. This reduces the time necessary to secure blades to the cutting blade holder by eliminating the need to drill holes in the cutting blades and cutting blade holder and then using screws or other

fastening hardware to hold the pieces together. Depending on the bonding material used, this process may be reversed and repeated when replacement blades need to be secured to the cutting blade holder.

5 A further advantage achieved with the present invention is that the weight of the assembled cutting blade assembly is less than those in which cutting blades are secured to the cutting blade holder with screws or other mechanical devices, resulting in fewer problems of deformation of the cut product being produced due to the weight of the cutting blade assembly. This is especially important with products that are very lightweight, fine or small in size, and therefore more likely  
10 to be deformed.

Still another advantage achieved with the present invention is that in certain arrangements, the cutting blade may be sharpened on both sides so that when the cutting edge on one side of the blades becomes dull, the cutting blade holder may be reversed on the mounting hub. This lengthens the amount of time a cutting  
15 mechanism may be used before it must be removed and sharpened, resulting in less down time on production lines.

As a result of the foregoing, another advantage achieved with the present invention is that when old cutting blades may not be sharpened again and ultimately need to be replaced, the old cutting blades may be de-bonded, and the  
20 cutting blade holder may be reused with new cutting blades secured thereto, further reducing costs.

Another advantage achieved with the present invention is that after the cutting blade is secured into the cutting blade holder, the cutting blade may be sharpened as necessary to ensure the cutting edge is flat and perpendicular to the  
25 material being cut, thus ensuring the material is not deformed when it is being cut.

Another advantage achieved with the present invention is that the number cutting blades around the diameter of the extrusion drive machinery may be increased because the width and weight of the cutting blade assembly is reduced. More cutting blades results in more frequent cuts, and thus reduces the speed at which the cutting mechanism needs to rotate for a given size of cut, which reduces the wear on the equipment. The rotating speed is typically between 1 and 1500 revolutions per minute (RPM), with 600 RPM being an optimal rotating speed.

### **Brief Description of the Drawings**

FIGURE 1 is an exploded view of one arrangement of the present invention showing a cutting blade assembly.

FIGURE 2 is a view of a cutting blade assembly secured to an extrusion device that embodies the features of one arrangement of the present invention.

FIGURE 3 is a cross-section view a portion of a cutting blade assembly taken along line 3-3 of FIG. 2, showing the positioning of the cutting blade in relation to the cutting blade holder.

FIGURE 4 is a view of another arrangement of the present invention.

FIGURE 5 is a view showing the cutting blade and cutting blade holder in an alternative arrangement of the present invention.

### **Detailed Description of the Preferred Embodiment**

Referring now to FIGURE 1, the reference numeral 10 designates, in general, a cutting blade assembly embodying features of one arrangement of the present invention. As viewed in FIG. 1, the cutting blade assembly 10 includes a cutting blade holder made of a first material 12, with channels 14 into which a cutting blade 20 is inserted and secured by means of a bonding material 30. The

cutting blade holder 12 is preferably made of a material such as a mild steel or other material that is relatively inexpensive. Typically, such materials have a coefficient of thermal expansion of 0.000007 in./degree Fahrenheit. The cutting blade holder 12 defines a center opening 12a and holes 12b. The number of channels 14 in the cutting blade holder 12 may be varied to adapt the cutting blade assembly 10 to the material being cut, and the frequency of cuts to be made in the material. The cutting blade 20 is preferably made of a second material different from the first material, such as carbide, tungsten carbide or the like that can be sharpened and will retain a sharp edge. The cutting blade 20 is aligned in the channel 14 in the cutting blade holder 12, and secured by means of a bonding material 30, such as solder and the like, that preferably chemically bonds to the materials of the cutting blade holder 12 and cutting blade 20. In some cases, the bonding material 30 used must be heated to stimulate the chemical reaction, and the bond becomes permanent when the material 30 is returned to normal room temperature.

Referring now to FIGURE 2, an assembled view of a first arrangement of the cutting blade assembly 10, it can be seen that the cutting blade holder 12 is preferably configured with a number of channels 14 angularly spaced apart from each other about the center opening 12a of the cutting blade holder 12, each of which channels is configured for receiving a cutting blade 20, to be secured in the channel 14 with a bonding material 30. The cutting blade holder 12 defines a center opening 12a and drilled holes 12b for use in mounting on a machine shaft 40.

Referring now to FIGURE 3, it can be seen that in a first arrangement of the present invention, the cutting blade 20 has a sharpened edge 20a cut at an angle such that the cutting edge is parallel to the face 12c of the cutting blade

holder 12. If the cutting blade assembly is to be such that both sides may be used for cutting, both sides of the cutting blade 20 are sharpened, and an opposing edge 20b of the cutting blade 20 is also cut at an angle such that the cutting edge is parallel to a face 12d of the cutting blade holder 12. The centerline of the channel 14 is centered in the thickness of the edge of the cutting blade holder 12. The cutting blade 20 is preferably made of tungsten-carbide, carbide, or other like hardened materials, or made of a less hard material and coated with carbide, tungsten-carbide or other like hardened materials to provide a sharp, long-lasting cutting edge.

Typically, cutting blades 20 are inclined at an angle  $\alpha$  with respect to a plane defined by the face 12c of the cutting blade holder, and the blades extend past such plane by a height H. Accordingly, when the cutting blade assembly 10 is placed on a planar surface, such as a flat table, it is supported on the cutting blades 20. For precise, repeatable cuts, each blade must be a repeatable distance from the face of the extruder die when attached for use. To achieve this result, each blade is measured for deviation from a common plane. Typically, the maximum deviation from a common plane between blades is less than 0.005 inches, preferably less than 0.002 inches, and more preferably less than 0.001 inches. Thus, in use, the initial cutting edges of the blades rotate in a planar space not wider than 0.005 inches, preferably not wider than 0.002 inches, and most preferably not wider than 0.001 inches.

Referring now to FIGURE 4, the reference numeral 50 designates, in general, a cutting blade assembly embodying features of another arrangement of the present invention. As viewed in FIG. 4, the cutting blade assembly 50 includes a cutting blade holder 52, with a channel 54 along one end into which a cutting blade 60 is inserted and secured by means of a bonding material 30. The

cutting blade holder 52 is preferably made of a material such as a mild steel or other material that is inexpensive. The cutting blade holder 52 defines a center opening 52a used to secure the cutting blade assembly 50 to a commercially available cup 80, which is not separately claimed as part of the present invention, by means of a fastening mechanism 82, such as a bolt, machine screw, or the like. The number of cutting blade assemblies 50 attached to the cup 80 may be varied to adapt the cutting blade assembly 50 to the material being cut, and the frequency of cuts to be made in the material. The cup 80 is mounted to the hub end of an extrusion device. The cutting blade 60 is preferably made of a material such as carbide, tungsten carbide or the like that can be sharpened and will retain a sharp edge. The cutting blade 60 is aligned in the channel 54 in the cutting blade holder 52, and secured by means of a bonding material 30, such as solder and the like, that preferably chemically bonds to the materials of the cutting blade holder 52 and cutting blade 60. In some cases, the bonding material 30 used must be heated to stimulate the chemical reaction, and the bond becomes permanent when the bonding material 30 is returned to normal room temperature.

Referring now to FIGURE 5, it can be seen that the cutting blade assembly 50 comprises a cutting blade holder 52, a cutting blade 60, and bonding material 30. The cutting blade holder 52 is preferably made of a material such as a mild steel or other material that is inexpensive. The cutting blade holder 52 defines a center opening 52a used to secure the cutting blade assembly 50. A channel 54 is contained in end of the cutting blade holder 52. The cutting blade 60 has a sharpened edge 60a cut at an angle to the channel 54 that is appropriate for the extrusion mechanism and material being extruded. The cutting blade 60 is preferably made of tungsten-carbide, carbide, or other like hardened materials, or



made of a less hard material and coated with carbide, tungsten-carbide or other like hardened materials to provide a sharp, long-lasting cutting edge.

It is understood that the present invention can take many forms and embodiments. The embodiments described herein are intended to illustrate rather than to limit the invention. Accordingly, several variations may be made in the foregoing without departing from the spirit or the scope of the invention. For example, the cutting blade assembly 10, 50 may be attached to a shaft of a machine other than an extrusion machine, or may be secured in a different manner than attaching to a machine shaft. The cutting blade holder 12, 52 and cutting blades 20, 60 may be made of a variety of materials, metallic or non-metallic, as appropriate to the cutting function being performed. The bonding material 30 may be solder, or some other glue, bonding material or the like that bonds well with the materials of which the cutting blade holder 12, 52 and the cutting blade 20, 60 are made.

Although illustrative embodiments of the invention have been shown and described, a wide range of modification, change, and substitution is contemplated in the foregoing disclosure and in some instances, some features of the present invention may be employed without a corresponding use of the other features. Accordingly, it is appropriate that the appended claims be construed broadly and in a manner consistent with the scope of the invention.